Analysis of TES Observations from the 2006 TexAQS/GoMACCS Campaign

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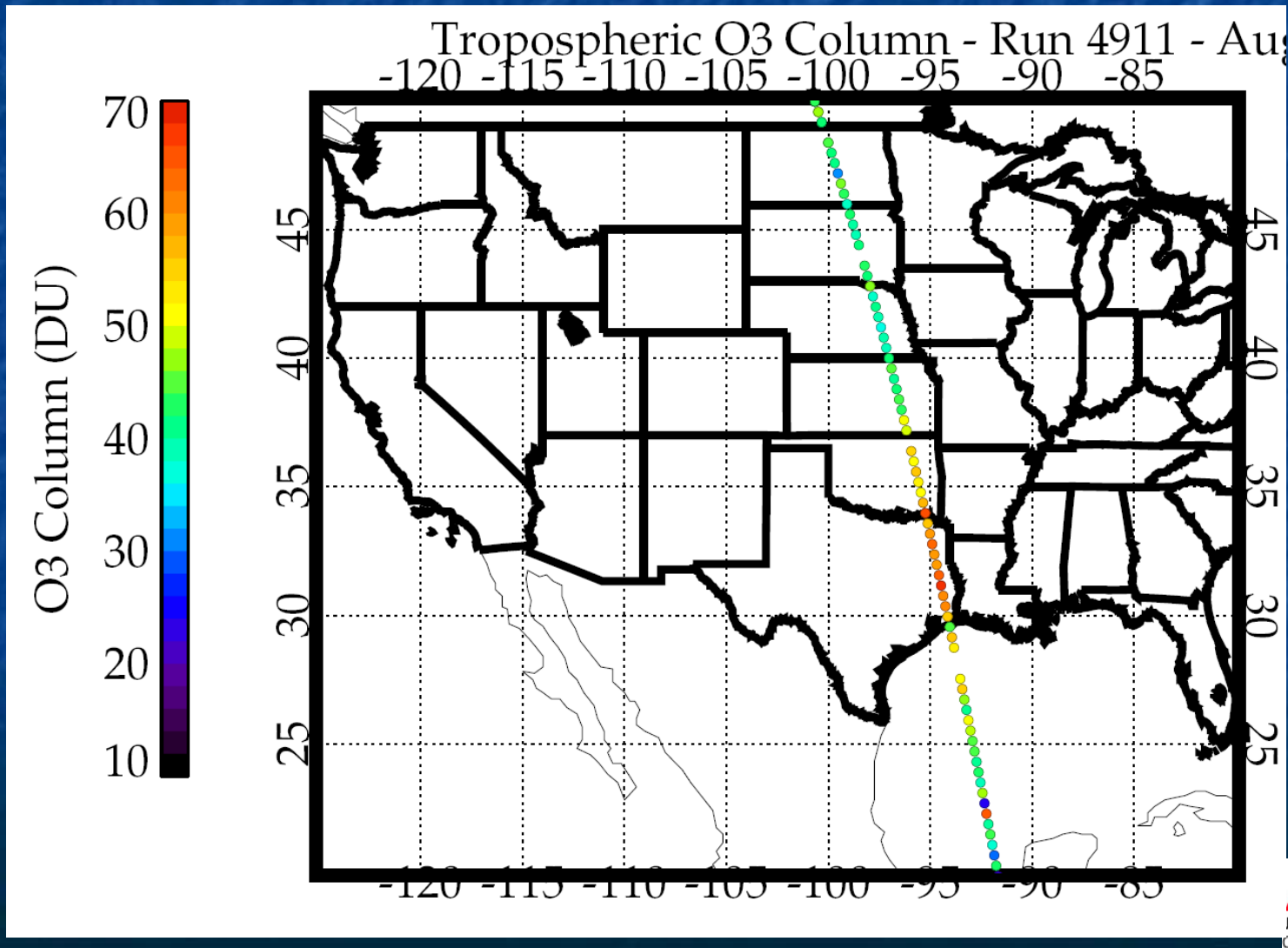
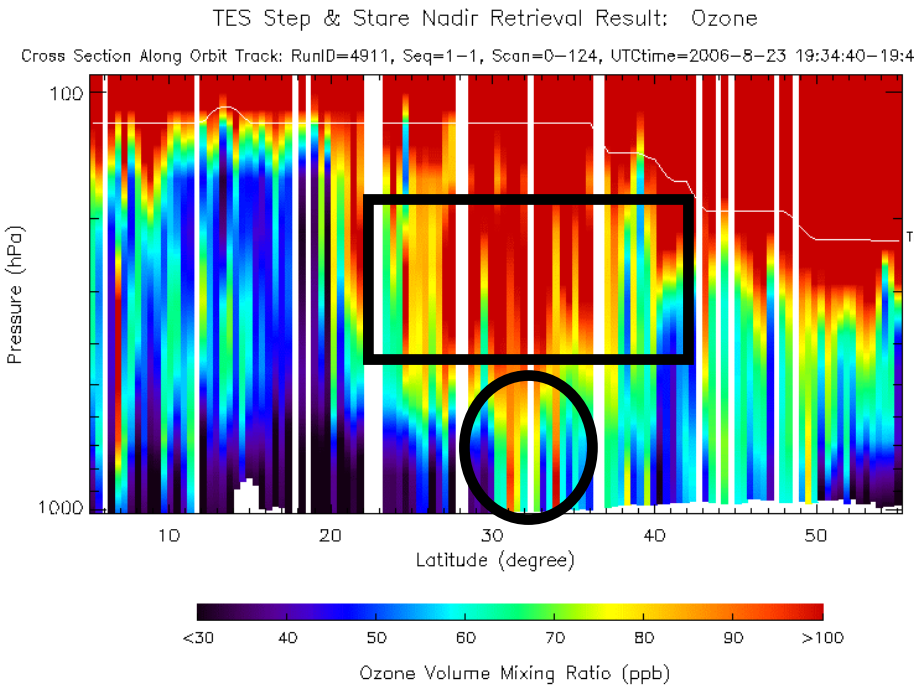
Synthesis of satellite observations, *in situ* measurements, and chemistry and transport models

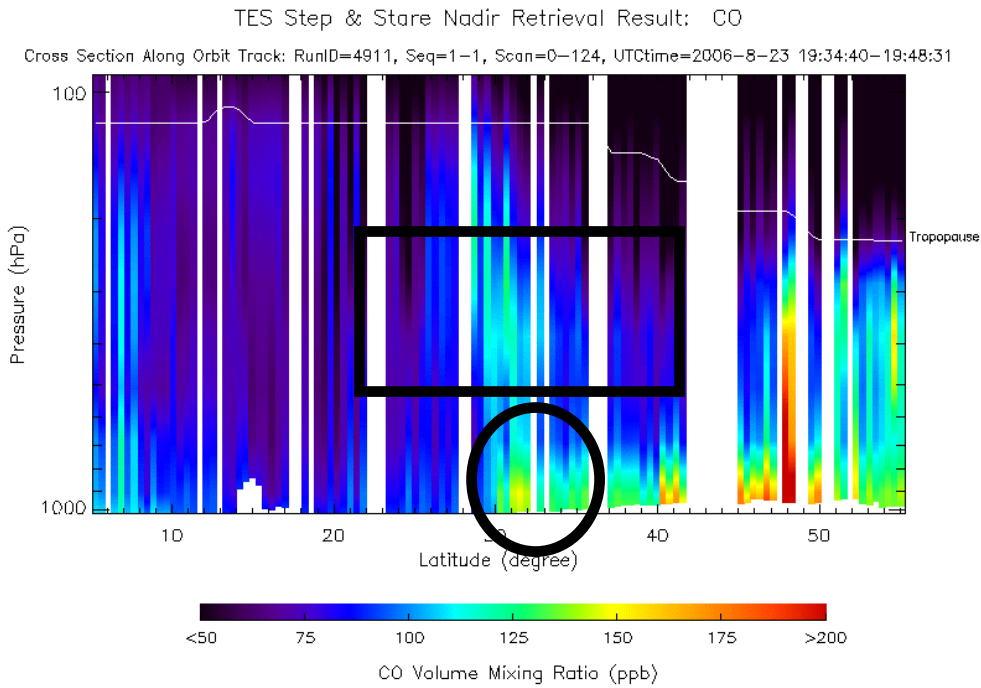
- Observations of ozone and carbon monoxide profiles in the free troposphere from TES can provide critical information for studying boundary layer exchange.
- Ground *in situ* observations such as AIRNow are the standard for boundary layer measurements of ozone and its precursors
- Chemistry and transport models such as the real-time air quality modeling system (RAQMS) are the critical link between these two observations
- The TexAQS/GoMACCS Campaign provided opportunities to test the synthesis of these tools

TES Step & Stare on August 23, 2006



Elevated CO and O3 over Houston region observed from TES Step & Stare on August 23, 2006





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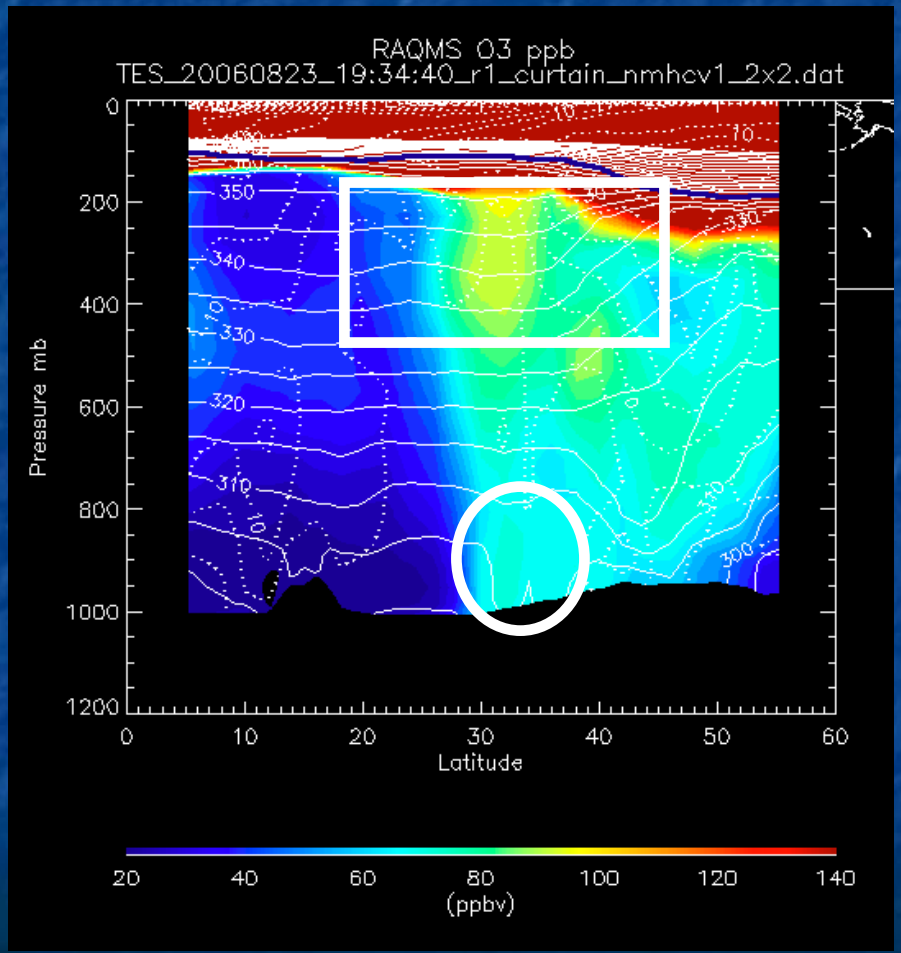
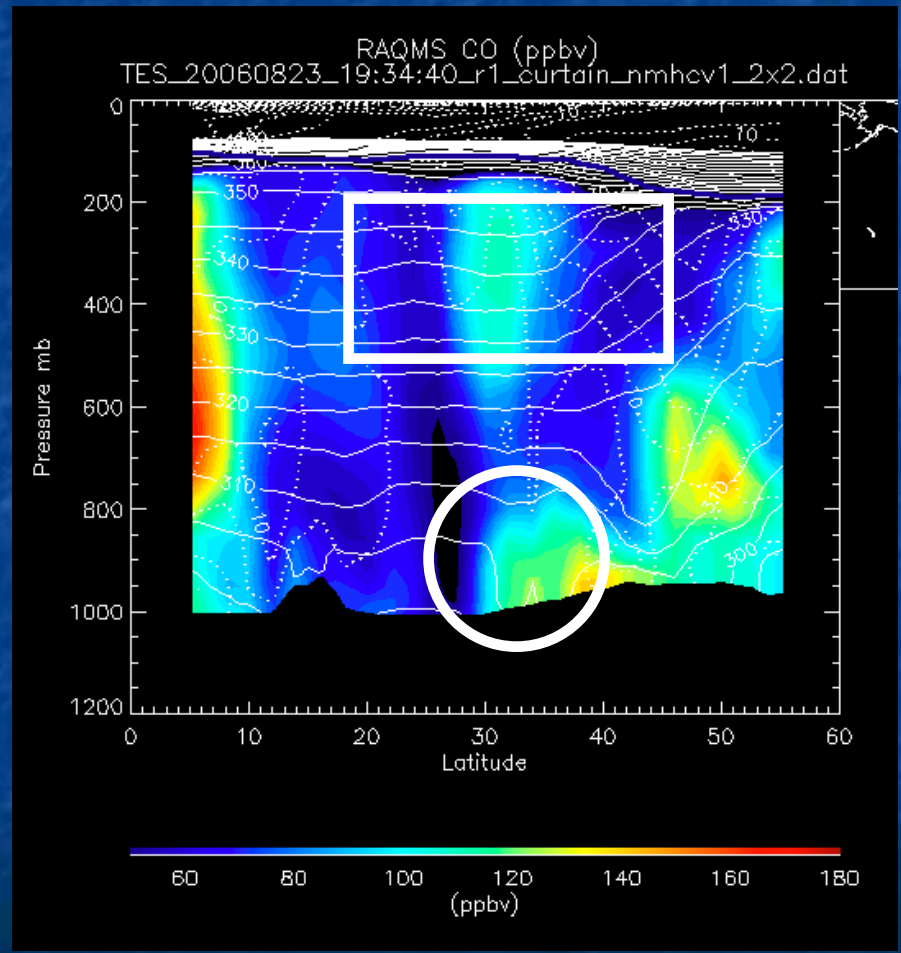
RAQMS CO and O3 Model Fields





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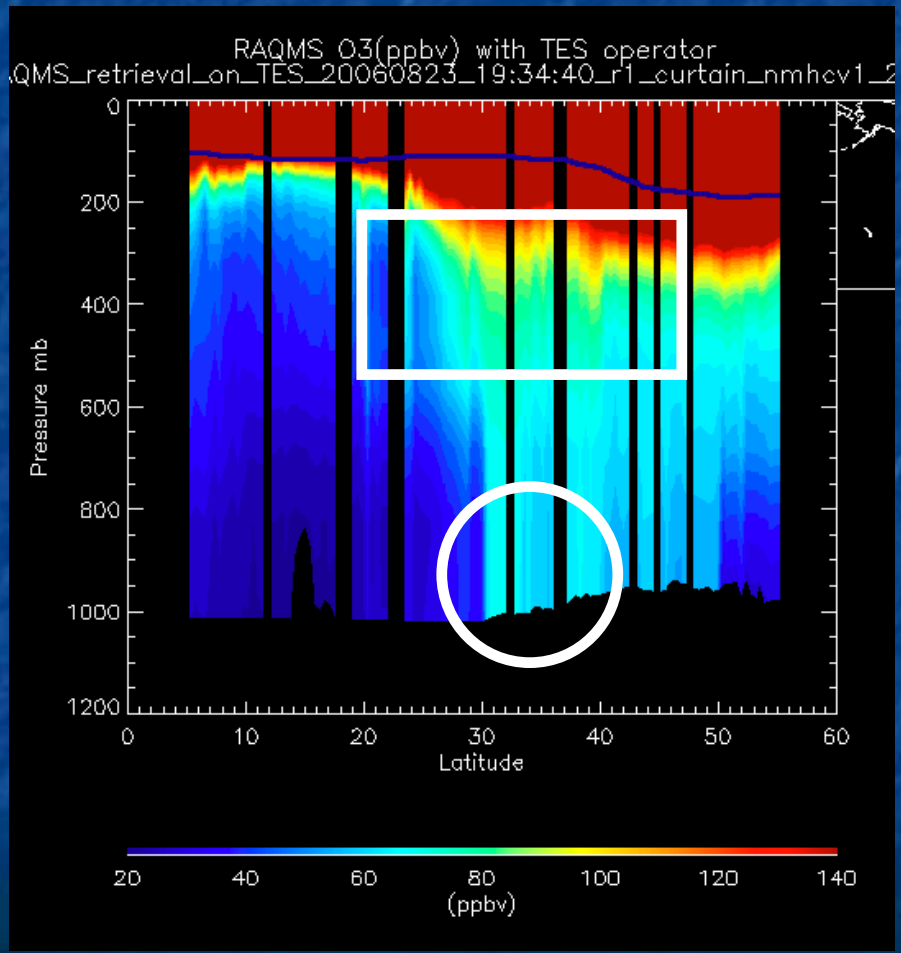
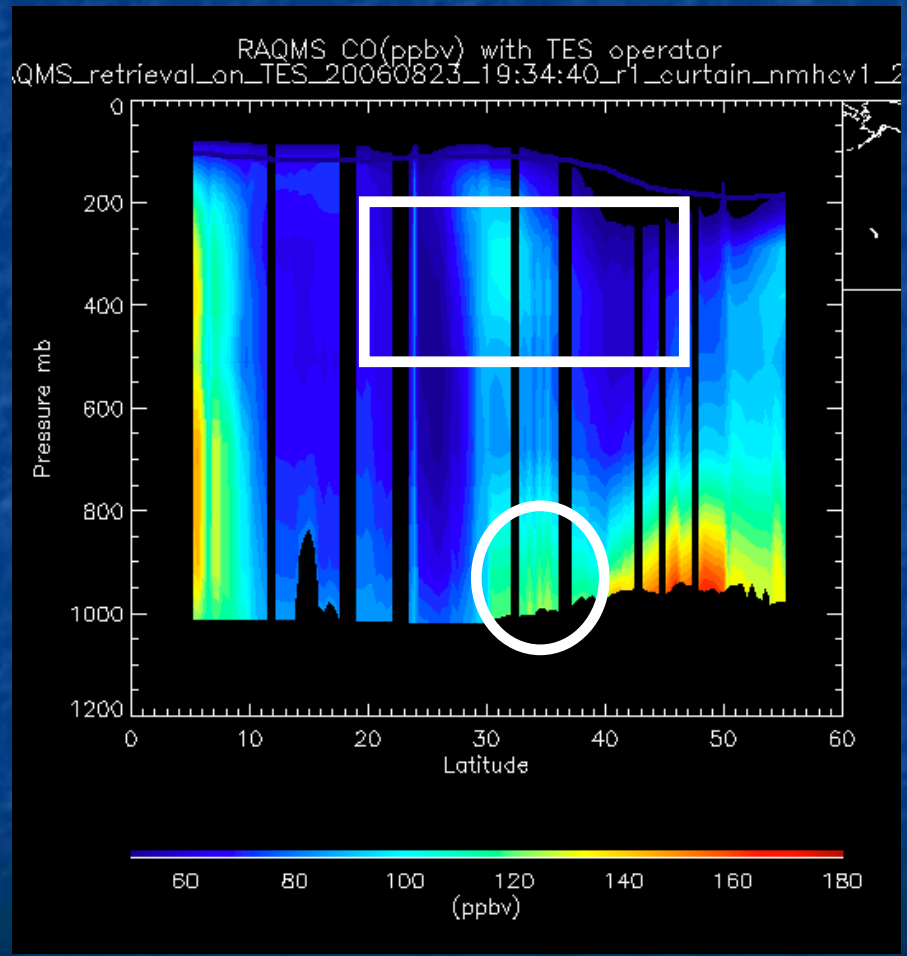
RAQMS with the TES *Observation Operator*





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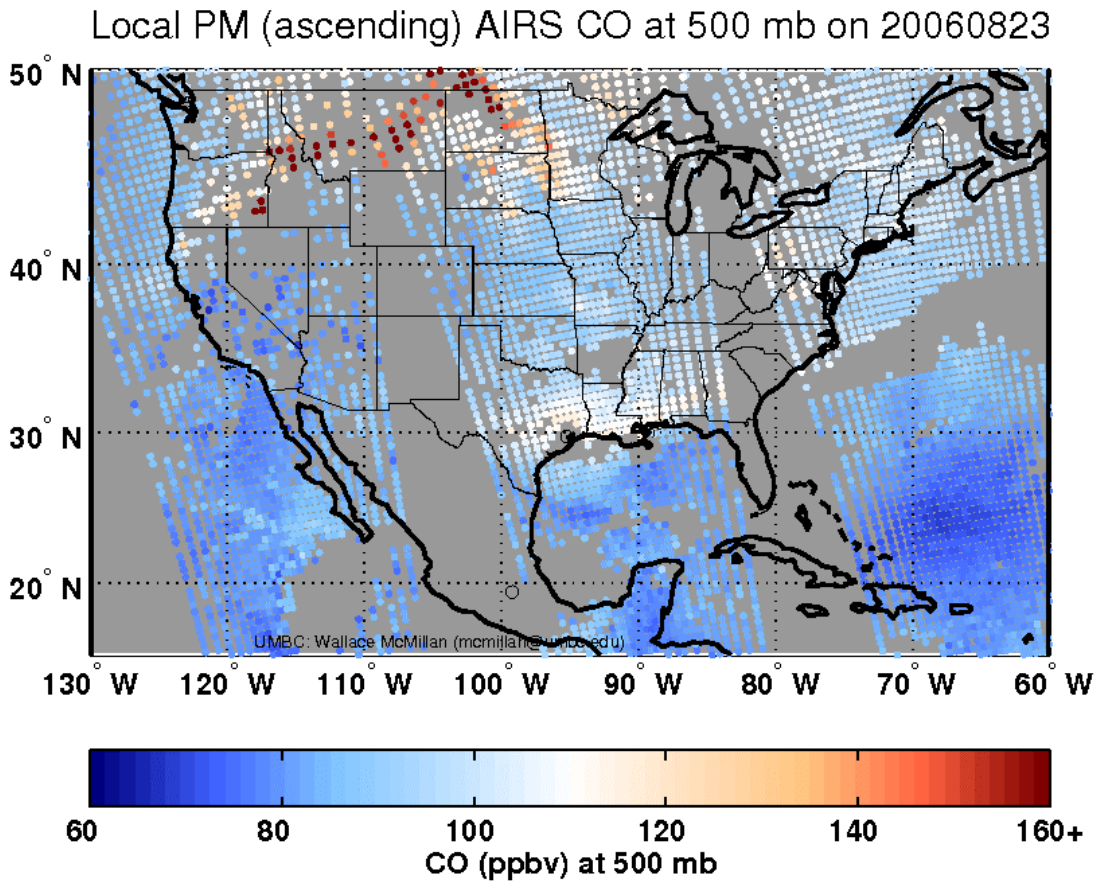
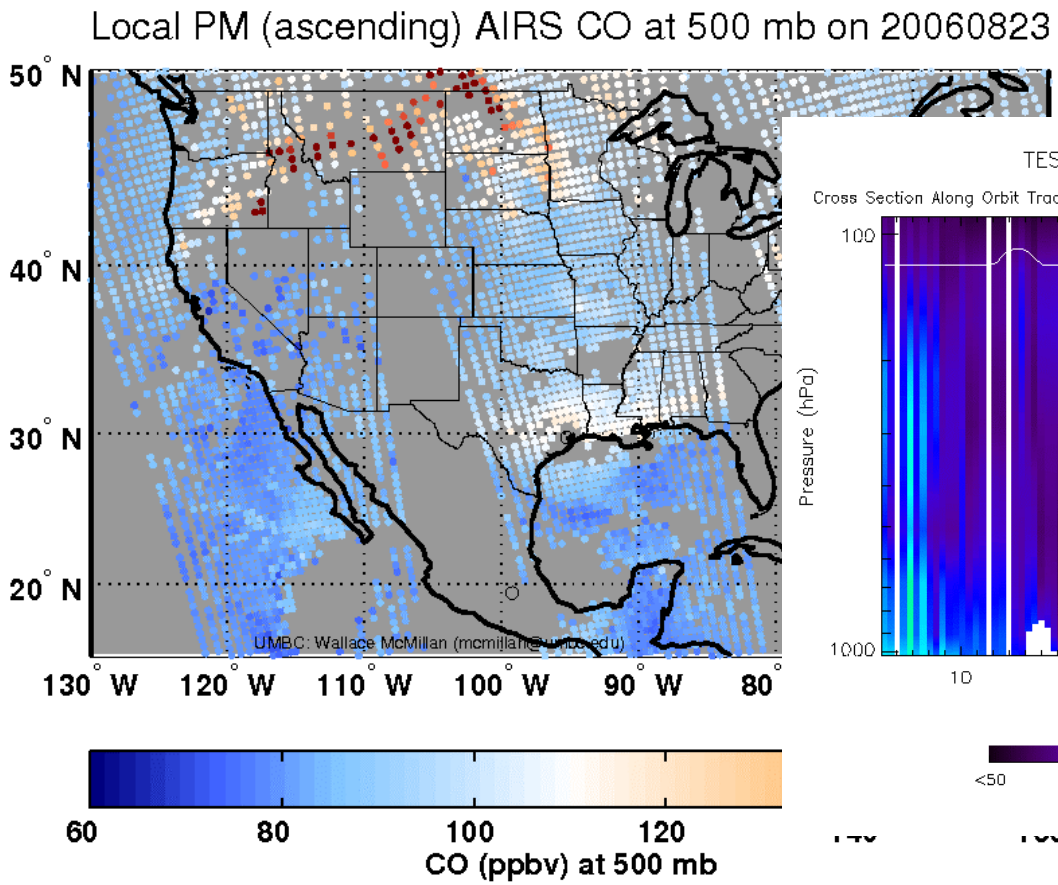
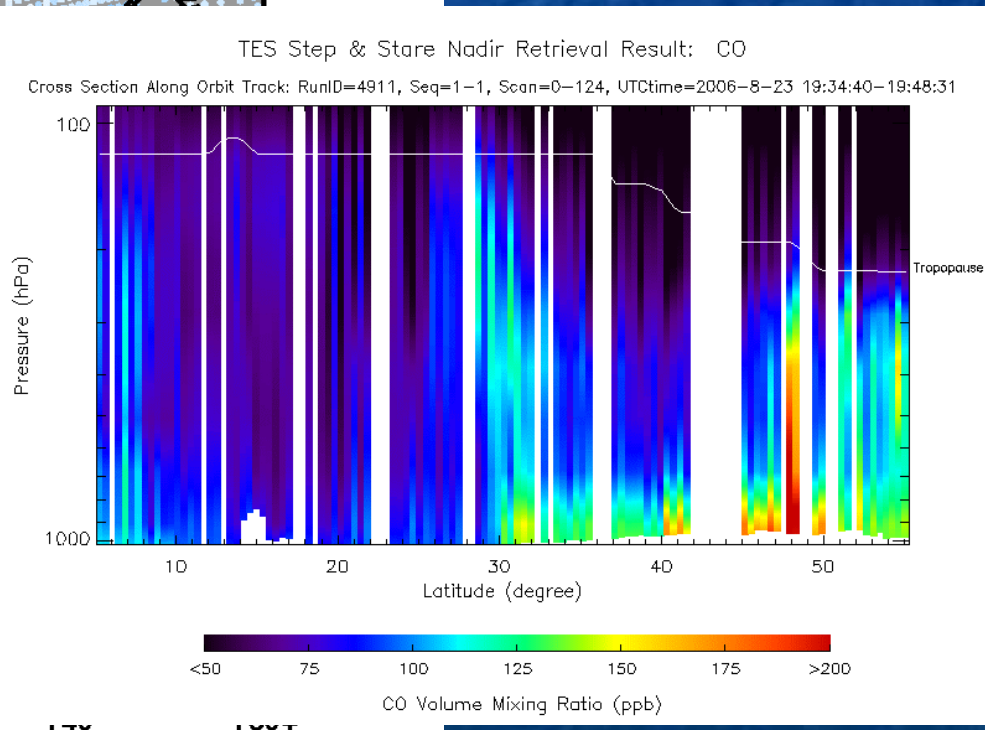
AIRS CO – August 23, 2006



AIRS & TES CO – August 23, 2006





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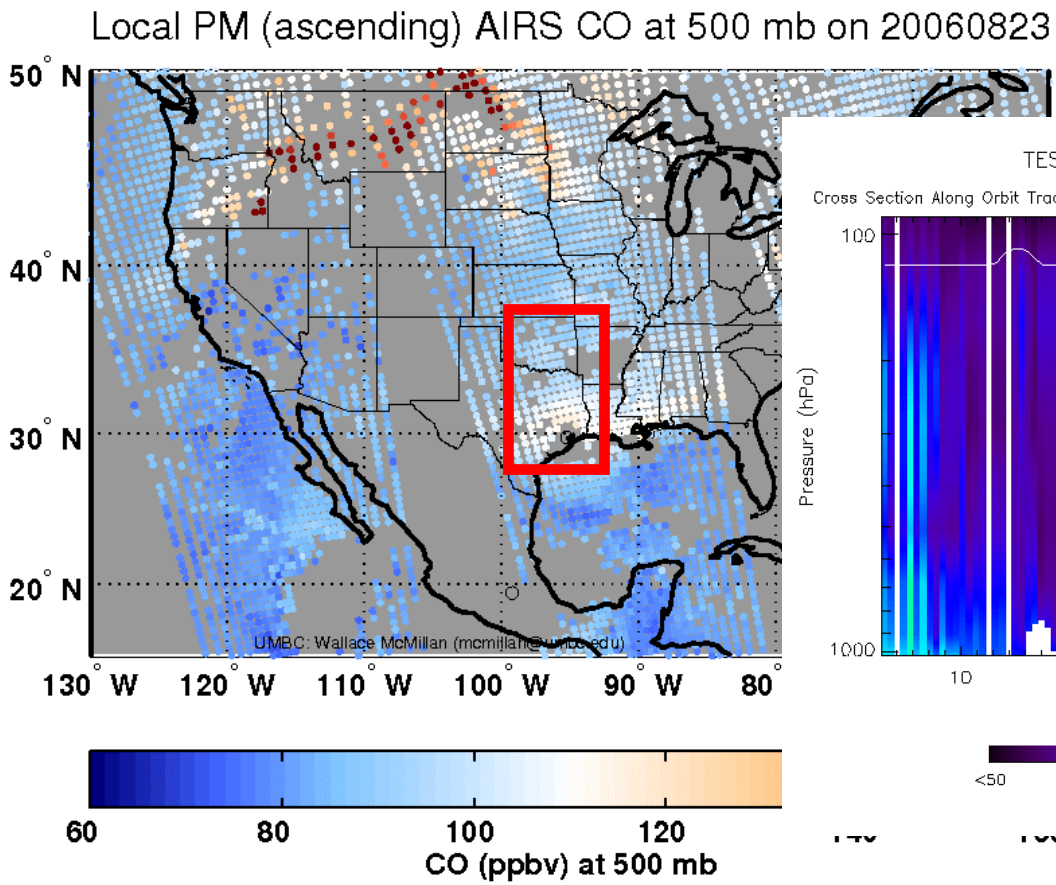
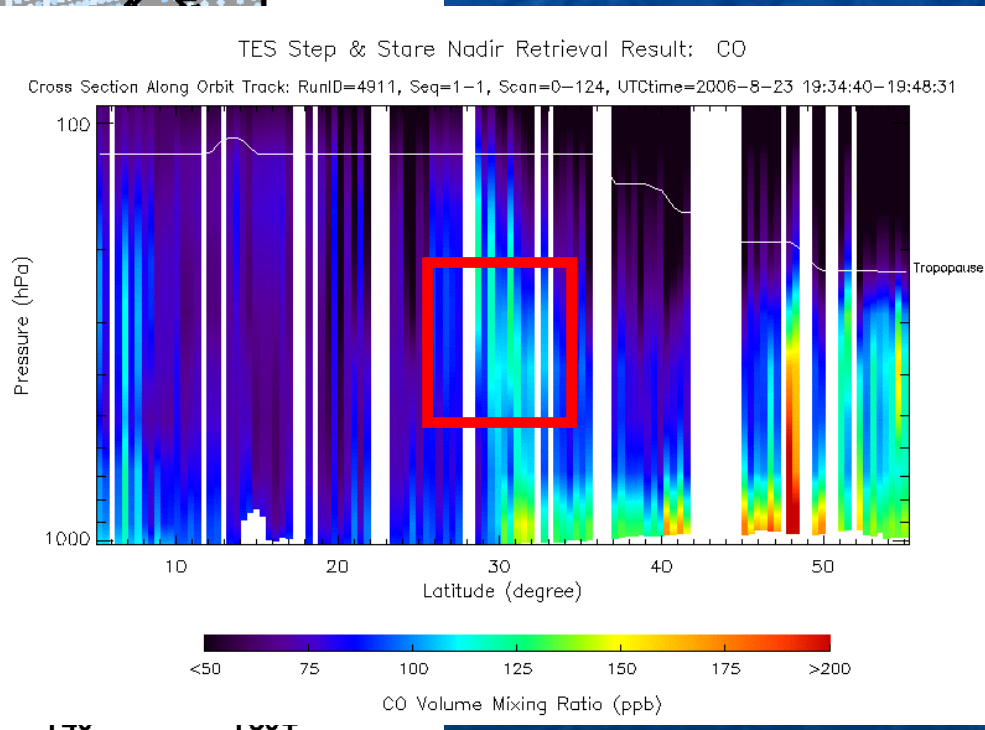
AIRS & TES CO – August 23, 2006





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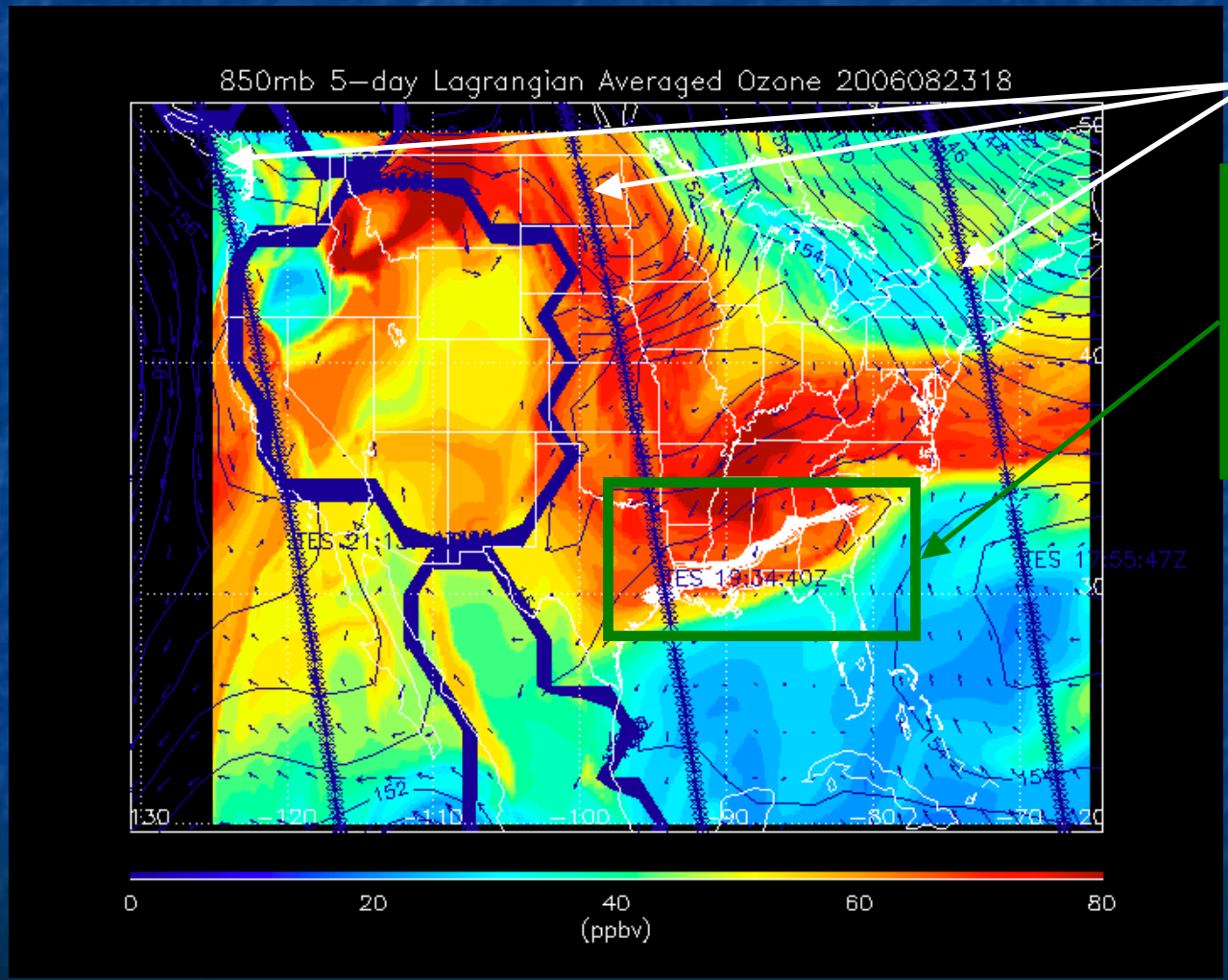
What is the origin of the ozone and CO enhancement?



- White lines represent 5-day back-trajectories emanating from Houston AIRNow Metropolitan statistical area (MSA) sites

Each point represents ozone averaged over a 5-day back-trajectory

Moderate values (60-70ppb) over Houston, but high values over Tennessee, Kentucky, Alabama, and Arkansas (~80 ppb)

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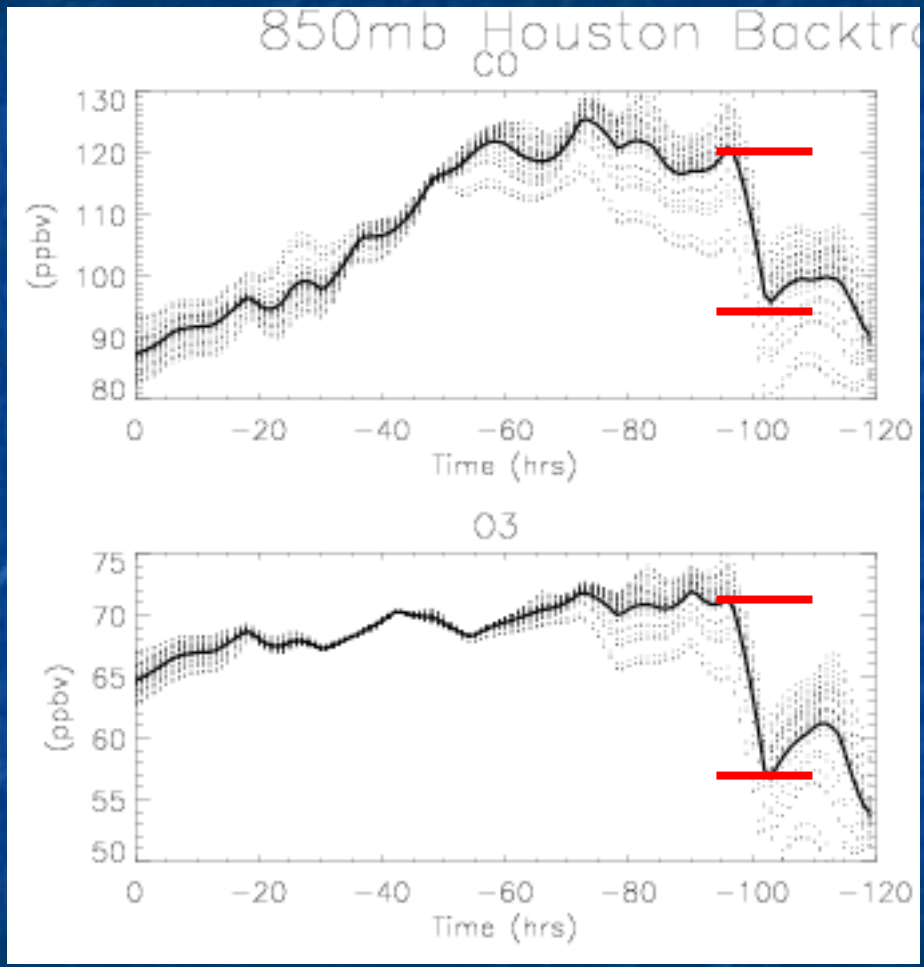
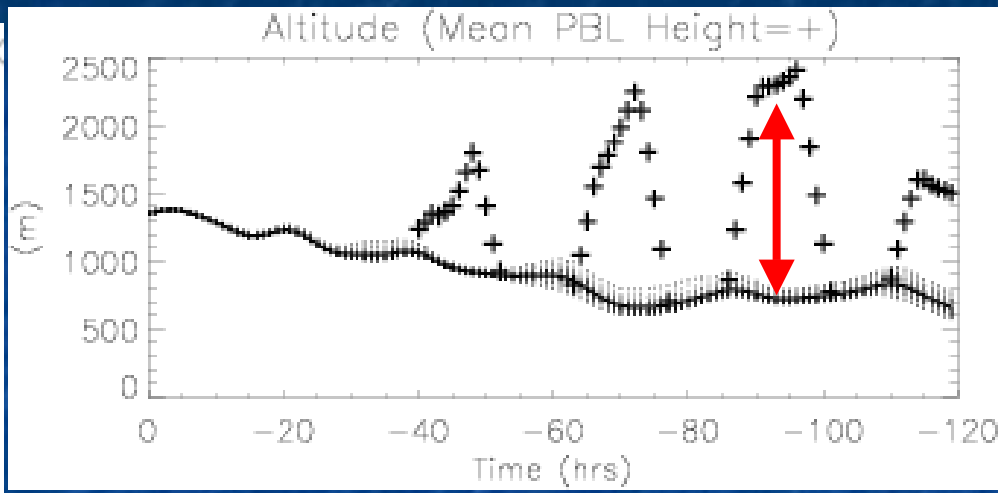
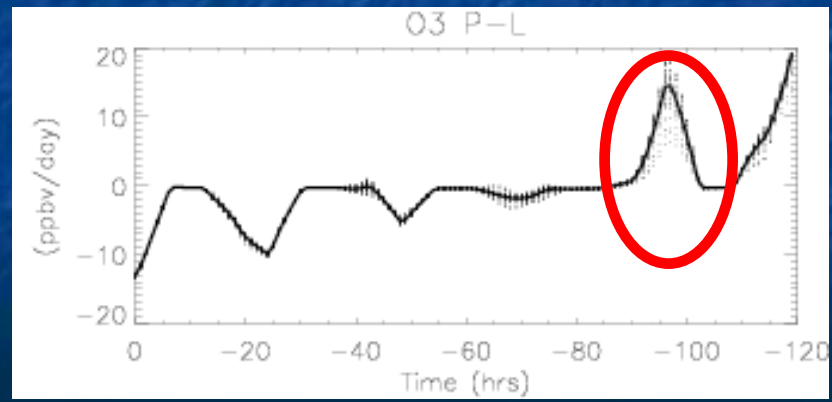
Process history of O3 and CO





Ozone production in the boundary layer about 4 days prior to arrival in Houston



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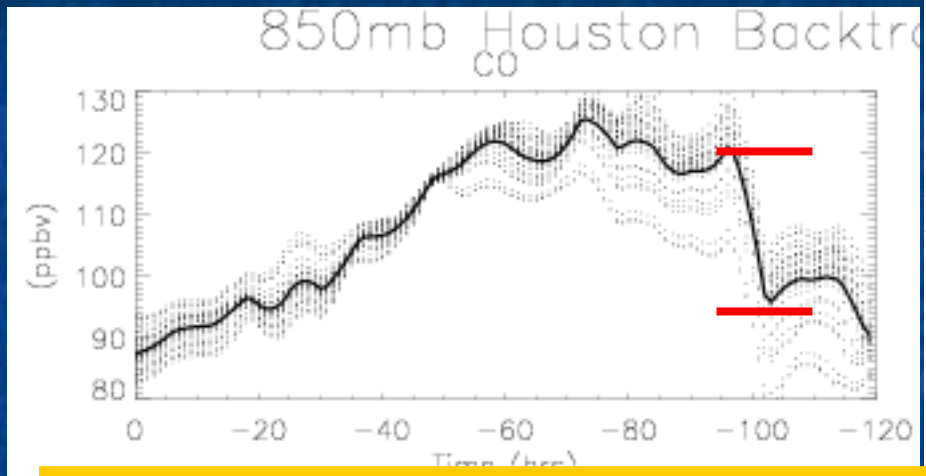
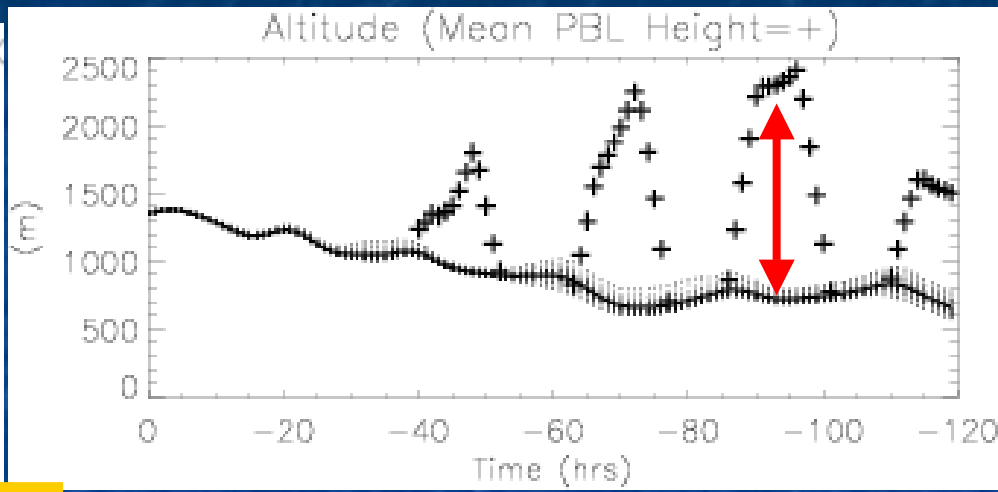
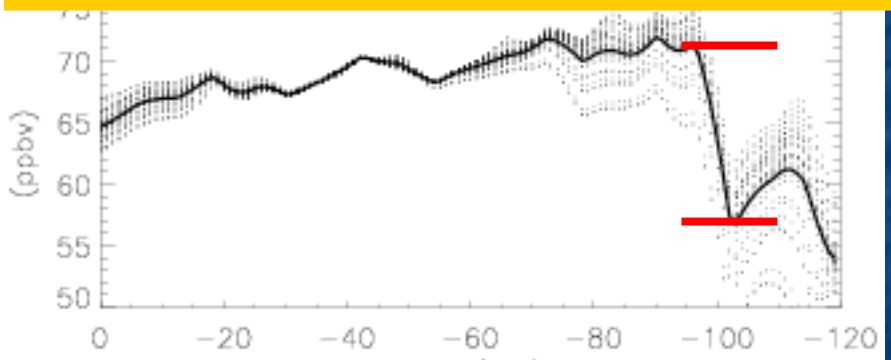
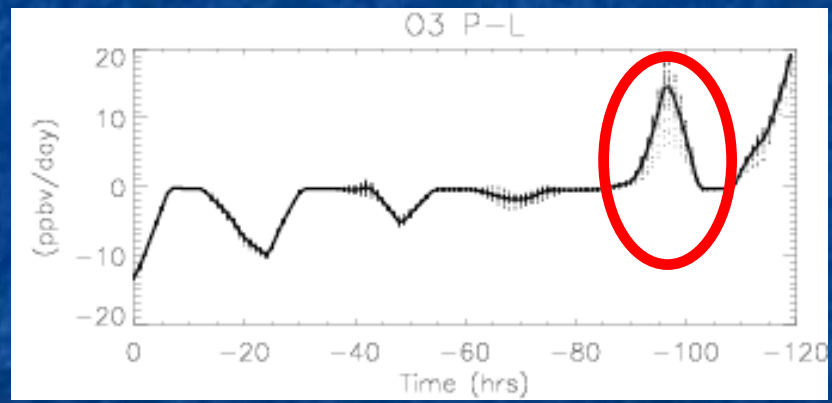




Increase in CO at about the same time





Ozone production in the boundary layer about 4 days prior to arrival in Houston

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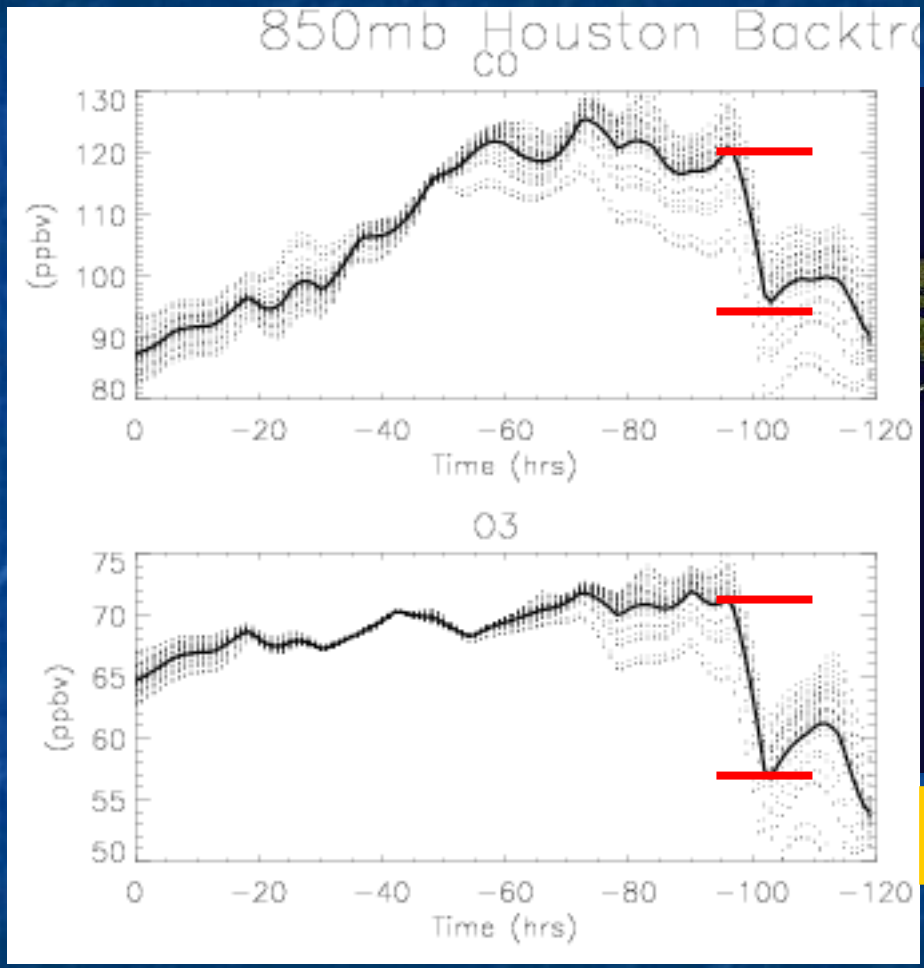
CO coming from Fires in SE US?



MODIS Fire Count Data for Aug 19-28, 2006

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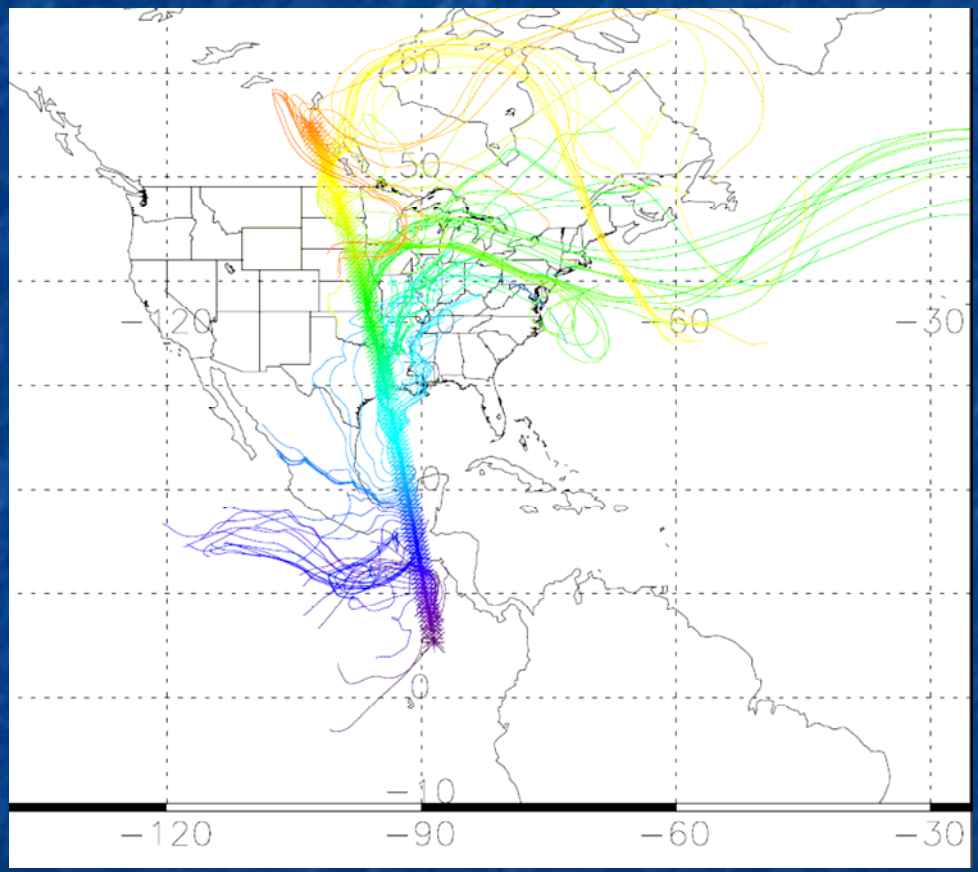
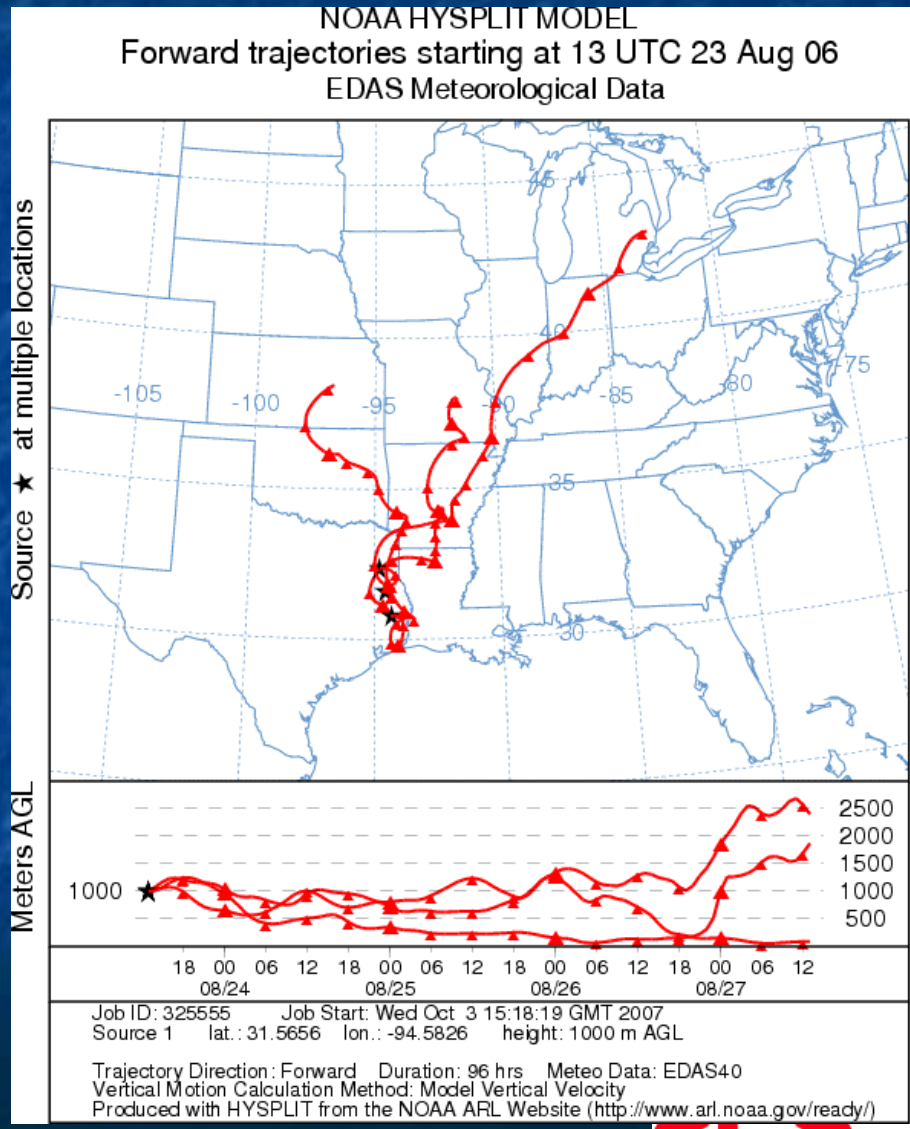
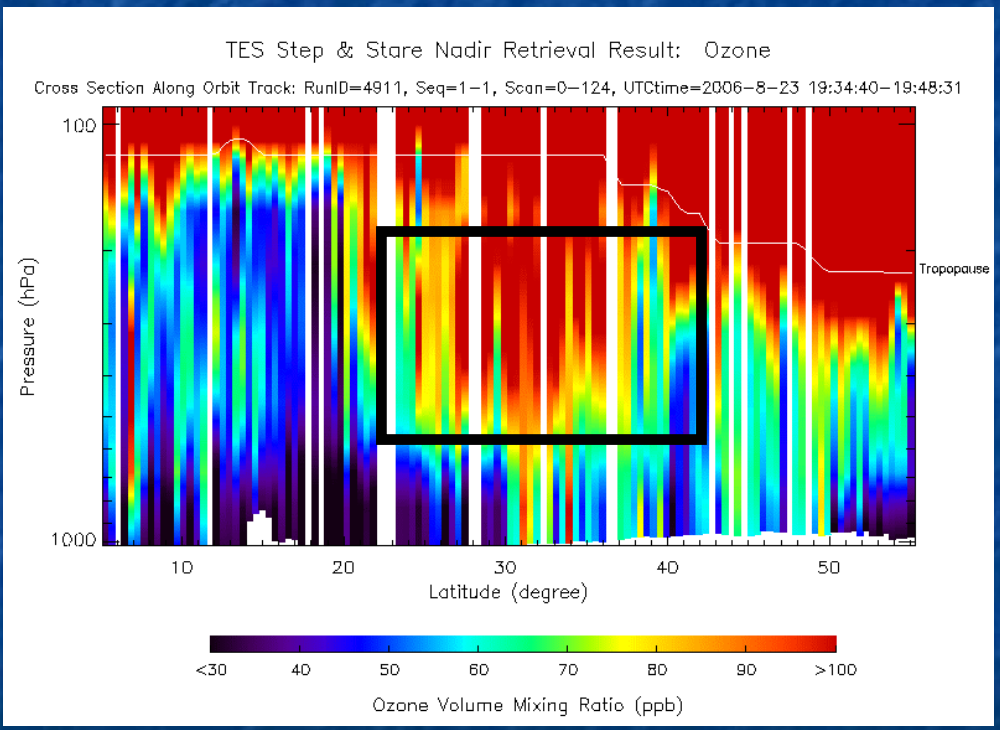
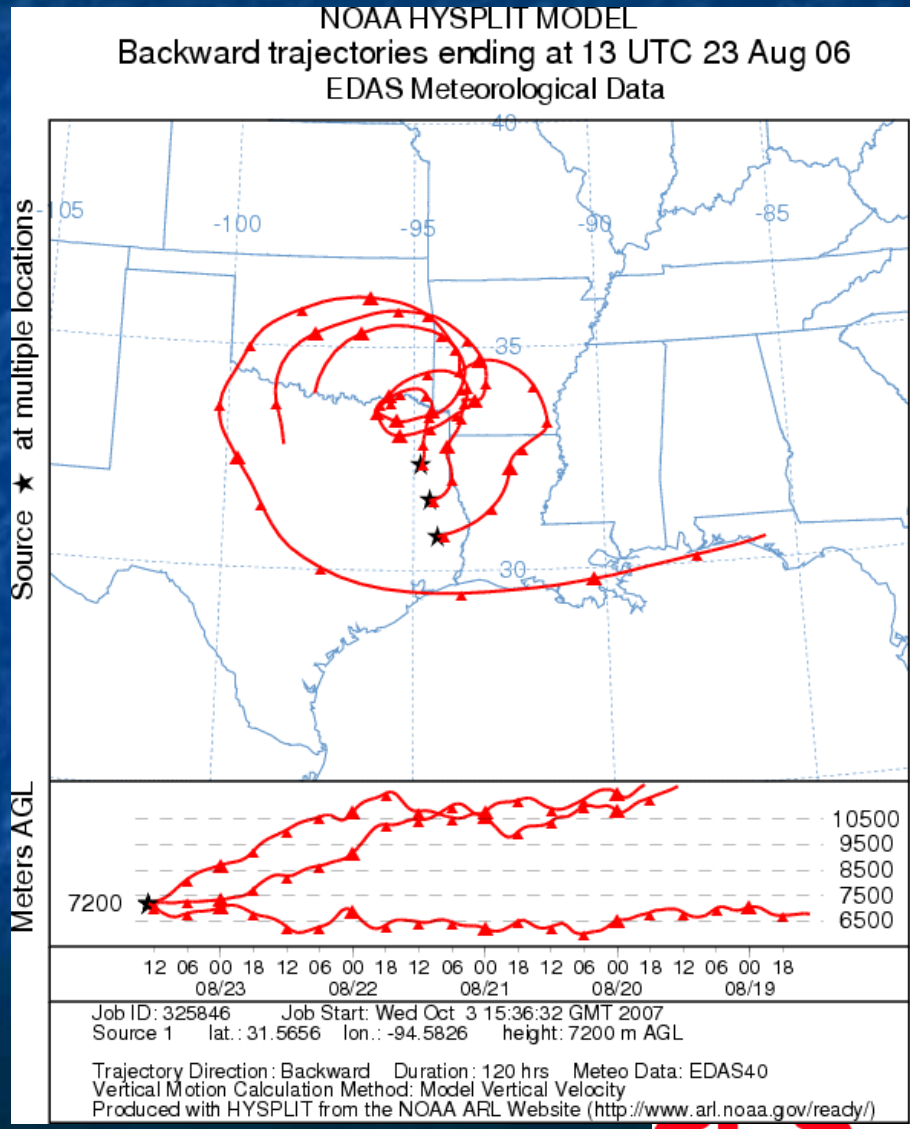
Forward Trajectories from TES Observations





Trajectories of O3 observed by TES at 422 hPa





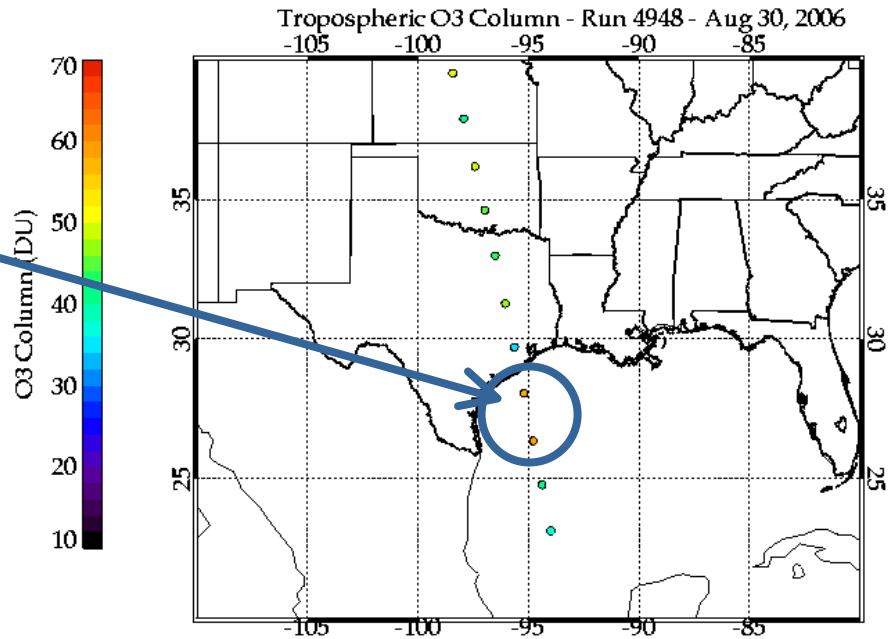
Conclusions from Aug 23 Case

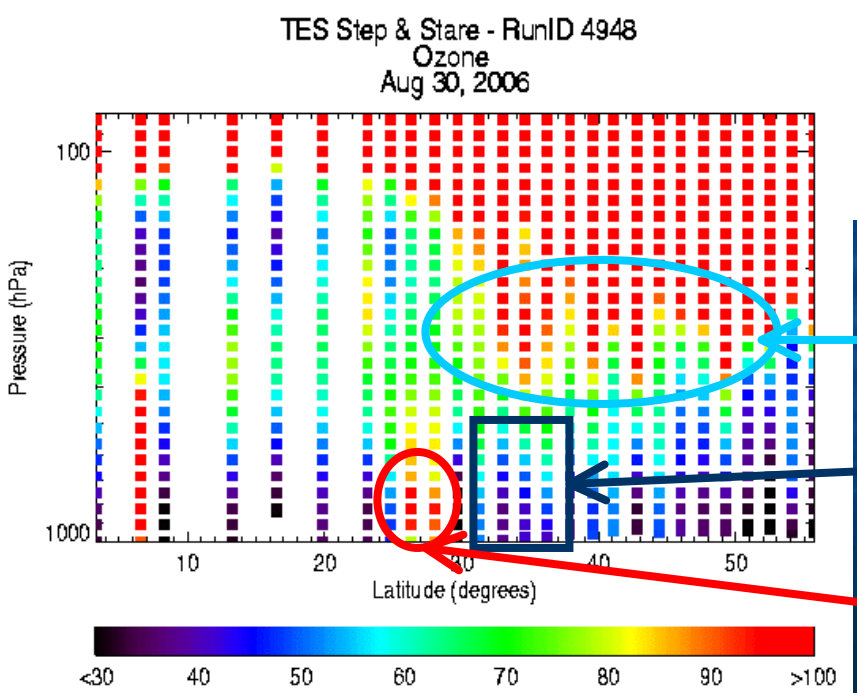
- Enhancement in both CO and O3 observed by TES east of the Houston area
  - Slightly higher values than in RAQMS fields
  - Consistent with AIRS CO and O3
- Model analysis suggests anthropogenic production of ozone from surface emissions at -90 hrs.
- MODIS Rapid Response maps suggest fires burning in SE United States throughout August
- Hysplit trajectories suggest ozone at 850 hPa observed by TES moved back over the Midwestern United States
- O3 observed in upper troposphere appears to come from the Southeastern US
- TES retrievals of CO and O3 vertical profiles in conjunction with the RAQMS global model provide a means of investigating the impact of distant sources on the background concentrations over Texas
  - Important concern of TCEQ and other researchers studying Air Quality in Texas
  - Ozone at 850 hPa on Aug 23rd, 2006 is above the boundary layer and therefore will have minimal impact on Houston air quality

Extra

TES Observations – Aug 30, 2006

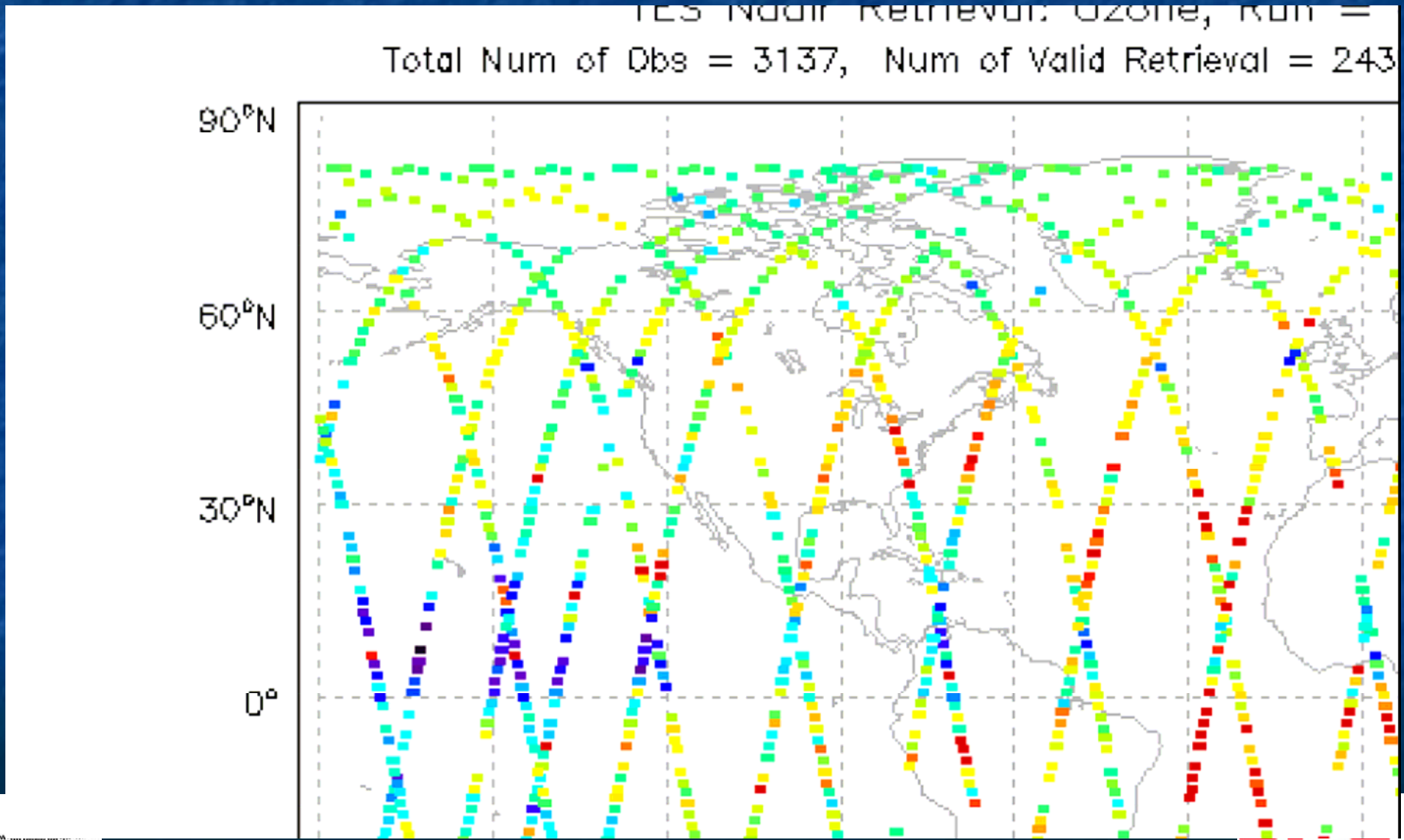
- TES Global Survey
- High ozone in the troposphere over the Gulf of Mexico seen in Trop Column
- Lower values over East TX





- Enhancement in ozone in middle troposphere over TX, OK, KA
- Low ozone in lower troposphere over East Texas, Central Oklahoma
- High ozone in lower troposphere over the Gulf (still under investigation)

Nighttime Ozone – Aug 26, 2006



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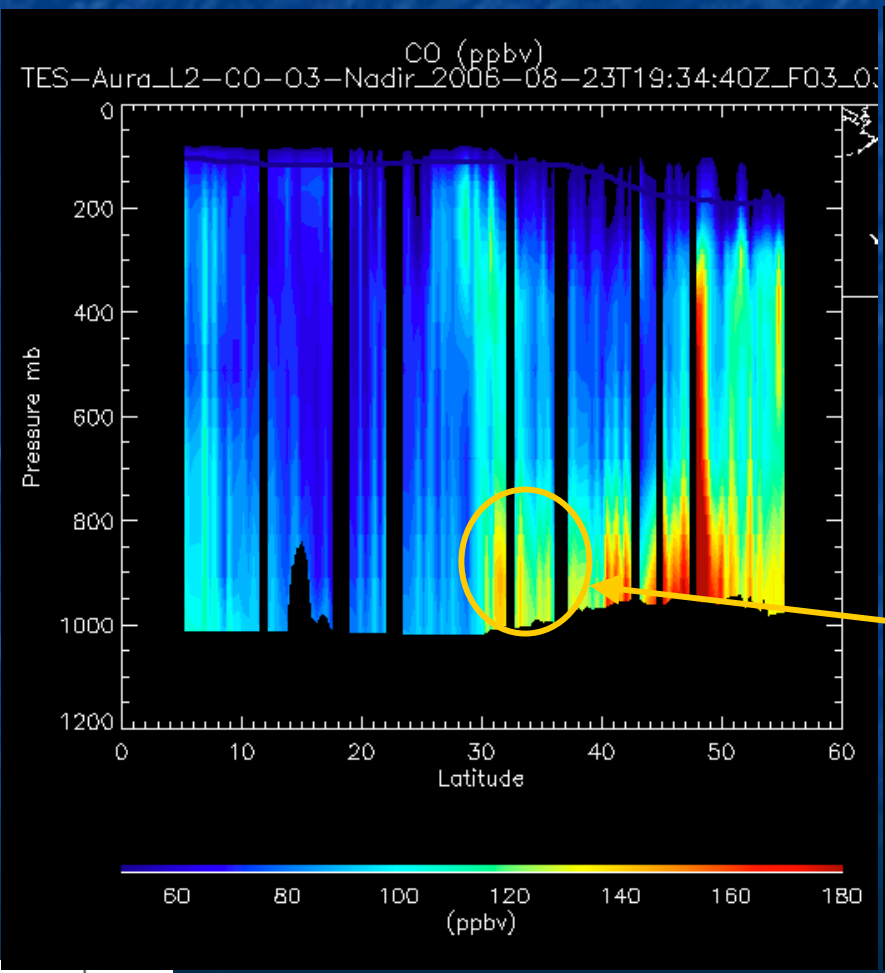

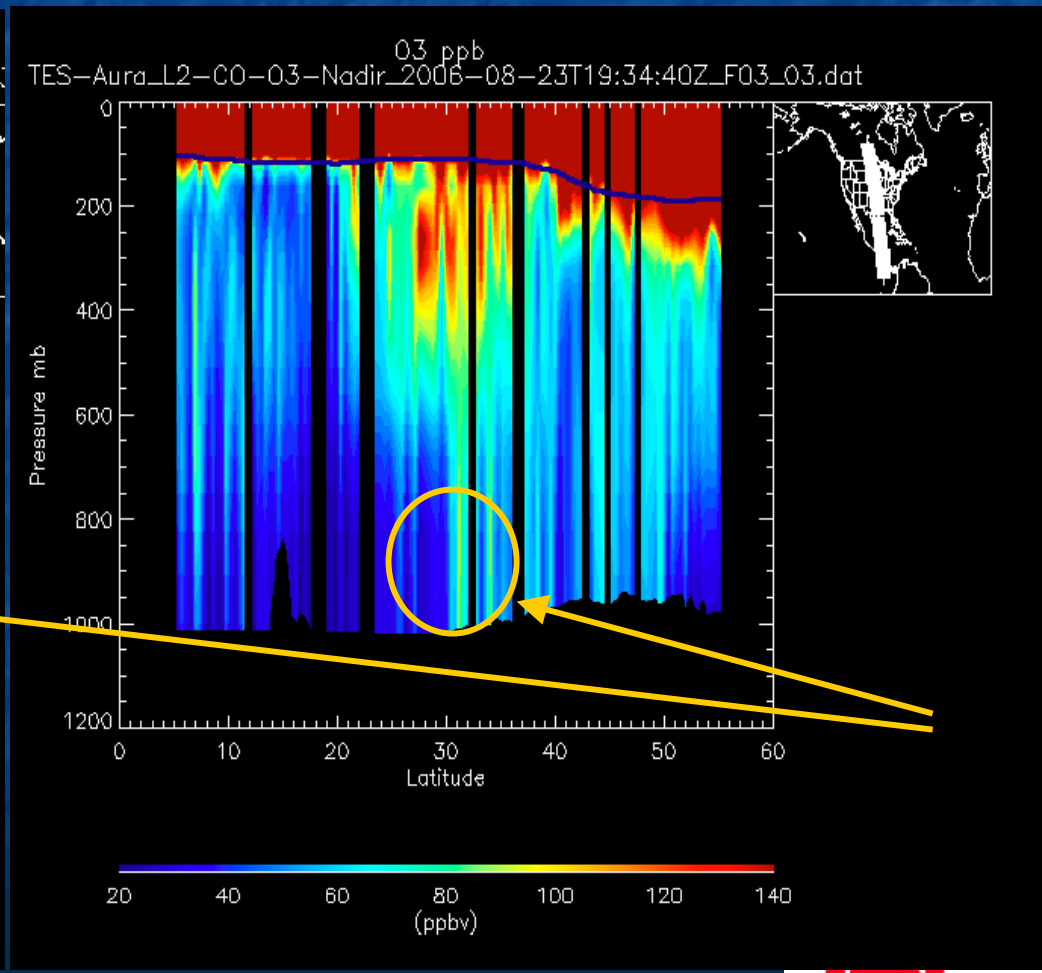

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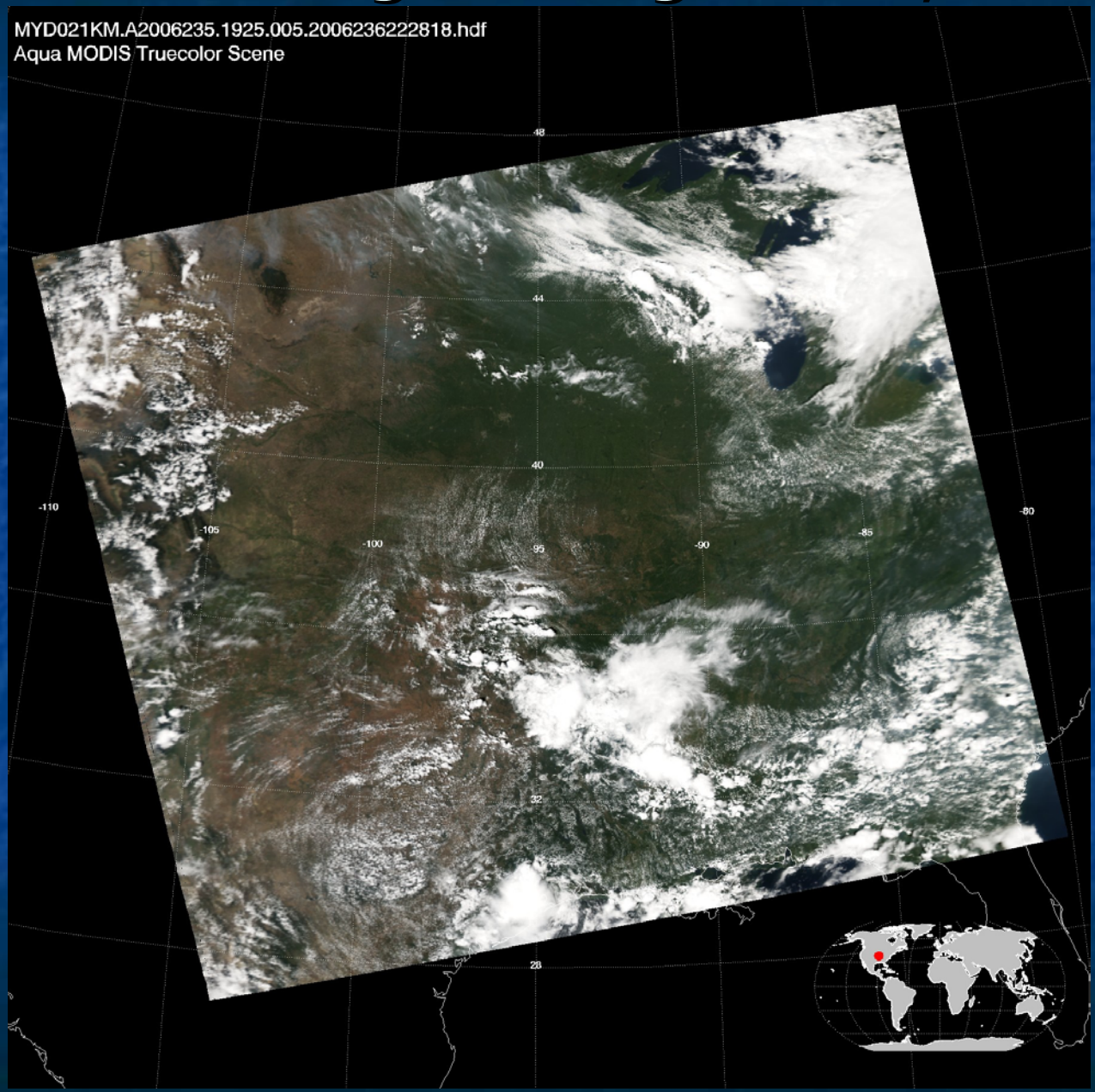
MODIS Image – August 23, 2006



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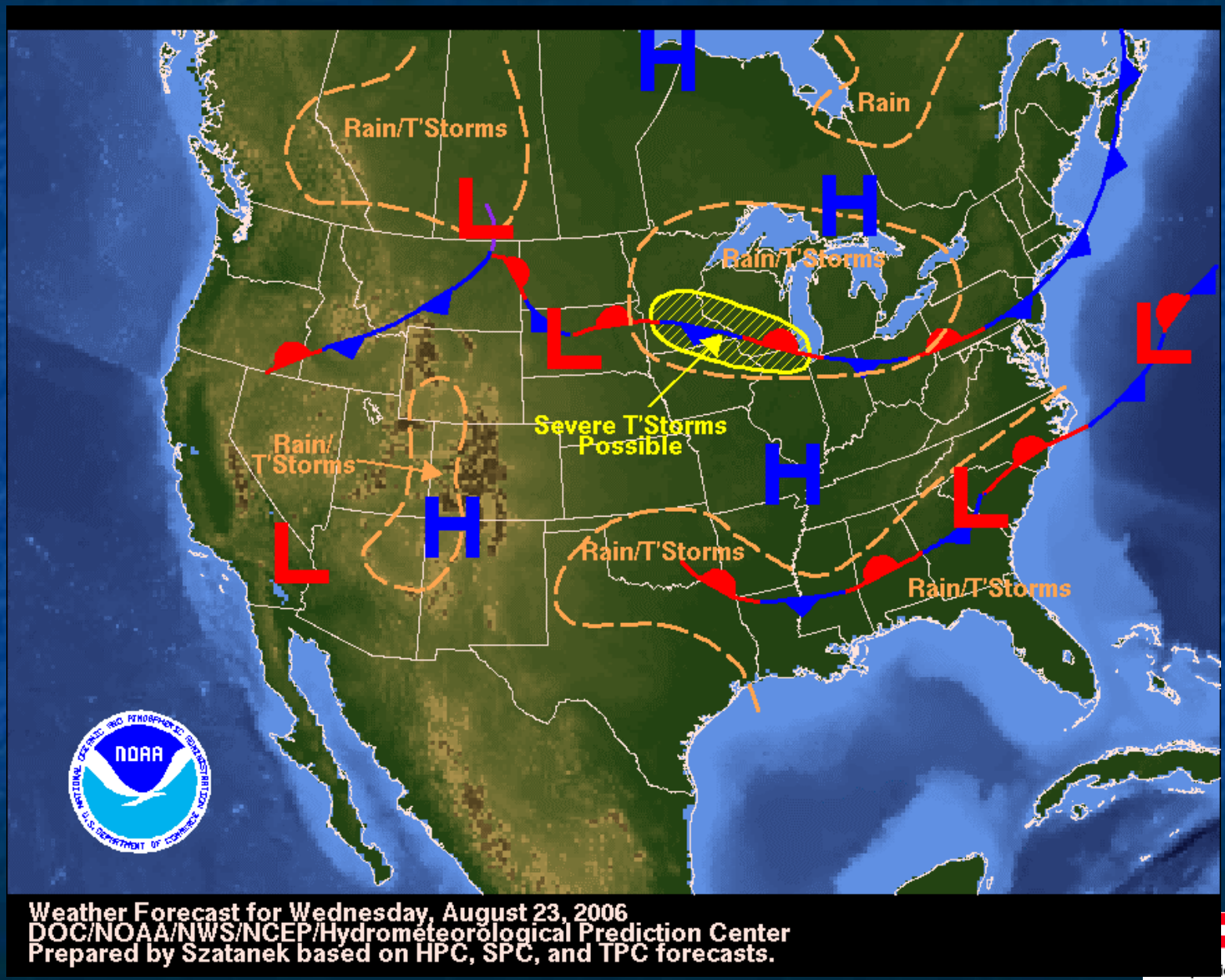
NOAA Forecast – August 23, 2006



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